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(54) EPOXY RESIN COMPOSITION AND POWDER COATING MATERIAL

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain the subject composition excellent in crack resistance, impregnation property, etc., and capable of being used as a powder coating material for a high speed rotary element by including an epoxy resin, curing agent, curing accelerator, inorganic filler and specific stress moderating agent.

SOLUTION: This epoxy resin composition contains (A) an epoxy resin as a mixed resin of preferably (i) a bisphenol type epoxy resin having 450-1000 epoxy equivalent and (ii) a novolak type multi-functional epoxy resin having 190-220 epoxy equivalent, (B) curing agent (preferably an acid anhydride, amide, etc., and especially preferably dicyandiamide), (C) a curing accelerator (preferably an imidazole, and especially preferably an imidazole-based

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TITLE: Epoxy! resin composition for powder coating - contains curing agent, curing promoter, inorganic filler, and styrene!-butadiene! rubber as stress reducing agent.

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ABSTRACTED-PUB-NO: JP 11092628A

BASIC-ABSTRACT:

An epoxy resin compsn. contains (A) epoxy resin, (B) curing agent, (C) curing promoter, (D) inorganic filler and (E) styrene-butadiene rubber as a stress-relaxing agent.

Also claimed are a powder coating consisting of the epoxy resin compsn. defined above and articles coated with the powder coatings,

USE - The article is a high-speed rotator for a motor.

ADVANTAGE - The powder coating has high adhesion, low modulus of elasticity, good thermoresistance, good crack resistance on a forced cooling after heat-curing, good appearance and good heat-cyclic resistance.

CHOSEN-DRAWING: Dwg.0/0

TITLE-TERMS: POLYEPOXIDE RESIN COMPOSITION POWDER COATING CONTAIN CURE AGENT CURE PROMOTE INORGANIC FILL POLYSTYRENE POLYBUTADIENE RUBBER STRESS REDUCE AGENT

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the epoxy resin system powder coatings which were excellent in the thermal resistance which has high adhesion and low elastic-modulus nature, the crack-proof nature by forced cooling after heat hardening, and a paint film appearance, and also were excellent also in thermo-cycle-proof nature, in order to fix the coil of the locked rotor of two flowers or the Starter motor for four-wheel cars about an epoxy resin constituent and powder coatings.
[0002]
[Description of the Prior Art] Conventionally, in order to make coils of a rotator especially used under an elevated temperature or a high speed, such as a motor and a generator, fix, using an epoxy resin system liquefied varnish is known. This liquefied varnish is used for the purpose of the vibration of a coil and rose ****** under protection of the coil under an elevated temperature, or high-speed rotation. the case where a liquefied varnish is not used -- the bottom of an elevated temperature -- the heat deterioration of the coil itself -- moreover, under high-speed rotation, vibration and rose injury student ** of a coil, and all cause trouble to the function of rotator original. In order to solve this trouble, the approach of fixing a coil with a liquefied varnish is adopted. After making it sink in and harden, specifically dropping and heating a liquefied varnish in the rotator core containing a coil, or core space, cutting processing is performed to extent to which a core surface of metal exposes excessive hardening resin from this rotator core front face with a cutting tool cutting edge etc., and it considers as a rotator.
[0003] The following process is taken when producing a locked rotor using an epoxy resin system liquefied varnish. That is, in order to heat the whole rotator core containing a coil to homogeneity so that (1) liquefied varnish may tend to sink in, a temperature up is carried out over many hours. (2) A liquefied varnish is dropped at the rotator core containing the heated coil, and hypoviscosity-ize a liquefied varnish with heat, make it get wet and spread and make it sink in into a coil or core space. (3) Make the liquefied varnish hypoviscosity-ized with heating gel. (4) In order to carry out full hardening, make it usually heat further for 1 to 2 hours. (5) Perform cutting processing to extent to which a core surface of metal exposes excessive hardening resin after full hardening with a cutting tool cutting edge etc., and consider as a product. Thus, when using an epoxy resin system liquefied varnish, a production process is long and productive efficiency is low. On the other hand, if the gelation time is brought forward in order to gather productive efficiency, the impregnating ability of a liquefied varnish becomes inadequate, and the fixing force of a coil will decline and it will become a defective. Moreover, since a liquefied varnish had short pot life, it was not reusable, and since viscosity was still lower, the lappet of a varnish arose before gelation, the amount of the liquefied varnish used increased, and the problem that cost rose was mentioned. In addition to these problems, contamination of work environment, the problem of an operator's insurance, etc. are mentioned by the odor accompanying use of the lappet of a liquefied varnish, or an organic solvent etc. It is pollution-free in order to solve these troubles, and powder coating possible [reuse of a coating] and very [in cost] advantageous attracts attention. However, in order to raise productive efficiency in the conventional powder coatings and to carry out

forced cooling of the rotator after heat hardening to a room temperature from 180 degrees C, it had the problem of producing a crack in a paint film. Although there is the approach of adding a filler and lowering coefficient of linear expansion in order to solve these problems, the problem that impregnating ability is inferior in this case arises.

[0004]

[Problem(s) to be Solved by the Invention] Powder coatings for locked rotors to which it has high adhesion and low elastic-modulus nature, and excels also in thermal resistance, the crack-proof nature by forced cooling after heat hardening, and a paint film appearance, and also thermo-cycle-proof nature is satisfied are desired.

[0005]

[Means for Solving the Problem] That a technical problem which was described above should be solved, this invention persons find out that the powder coatings which are satisfied with coincidence of the above-mentioned engine performance are obtained, as a result of repeating research wholeheartedly. This invention Namely, (1) epoxy resin (A), a curing agent (B), a hardening accelerator (C), The epoxy resin constituent which contains styrene-butadiene rubber (E) as an inorganic filler (D) and a stress relaxation agent, (2) The epoxy resin constituent of claim 1 whose epoxy resin (A) is mixed resin of the bisphenol mold epoxy resin (a) of weight per epoxy equivalent 450-1000, and the novolak mold polyfunctional epoxy resin (b) of weight per epoxy equivalent 190-220, (3) (1) or (2) epoxy resin constituents whose curing agent (B) is a dicyandiamide, (4) (1) whose a hardening accelerator (C) is an imidazole system azine derivative thru/or the epoxy resin constituent of any 1 term of (3), (5) An inorganic filler (D) is a calcium carbonate or a powder silica. (1) Or (1) the epoxy resin constituent of any 1 term of (4) and whose (6) inorganic filler (D) are powder silicas thru/or the epoxy resin constituent of any 1 term of (4), (7) A powder silica is a melting crushing silica, a crystal crushing silica, or a spherical silica. (5) Or it can set to the epoxy resin constituent of (6), and (8) styrene-butadiene rubber (E). Styrene : (1) whose component ratio of a butadiene is - (25:75) (45:55) thru/or the epoxy resin constituent of any 1 term of (7), (9) (1) whose a styrene butadiene rubber (E) is a styrene butadiene rubber which carried out epoxy denaturation of a part of butadiene section thru/or the epoxy resin constituent of any 1 term of (8), (10) Epoxy resin constituent of (9) whose rate of epoxy denaturation in the styrene butadiene rubber which carried out epoxy denaturation is all 5 in butadiene component - 25-mol %. Goods painted with the epoxy resin powder coatings and the epoxy resin powder coatings of (12) and (11) which consist of an epoxy resin constituent of any 1 term of (11), (1), or (10). (13) The motor, [0006] which have the goods of (12) whose goods are locked rotors, and the locked rotor of (14) and (13)

[The gestalt of invention implementation] The epoxy resin constituent of this invention contains styrene-butadiene rubber (E) as an epoxy resin (A), a curing agent (B), a hardening accelerator (C), an inorganic filler (D), and a stress relaxation agent. Although the heterocycle type epoxy resin which has heterocycles, such as cycloaliphatic epoxy resin which has aliphatic series frames which the glycidyl ether radical has combined with the phenol system compound, for example, such as an epoxy resin and a cyclohexane, as an epoxy resin (A), an isocyanuric ring, and a hydantoin ring, is mentioned, the epoxy resin which combines a glycidyl ether radical with a phenol system compound is desirable. However, the after-mentioned styrene-butadiene rubber by which epoxy denaturation was carried out is removed from this epoxy resin (A).

[0007] As a phenol system compound in the epoxy resin which the glycidyl ether radical has combined with the above-mentioned phenol system compound For example, a bisphenol A, Bisphenol F, Bisphenol S, 4, and 4'-biphenyl phenol, 2 and 2'-methylenebis (4-methyl-6-tert-butylphenol), 2 and 2'-methylenebis (4-ethyl-6-tert-butylphenol), 4 and 4'-BUCHIIREN-screw - (3-methyl-6-tert-butylphenol), 1, 1, 3-tris (2-methyl-4-hydroxy-5-tert-butylphenol), A tris HODOROKISHI phenylmethane, pyrogallol, the phenols that have a diisopropylidene skeleton, A polyphenol compound, various kinds of novolak resin, etc., such as phenols which have fluorene frames, such as a 1 and 1-G 4-hydroxyphenyl fluorene, and phenol-ized polybutadiene, are mentioned. As various kinds of novolak resin, various novolak resin, such as novolak resin which uses various phenols, such as a phenol, cresol, ethylphenol, butylphenol,

octyl phenol, bisphenol A, Bisphenol F, Bisphenol S, and naphthols, as a raw material, xylylene frame content phenol novolak resin, dicyclopentadiene frame content phenol novolak resin, and fluorene frame content phenol novolak resin, is mentioned.

[0008] these epoxy resins -- a kind -- or two or more sorts may be mixed and you may use. Moreover, when the fluidity (blocking nature under storage) of the fine particles at the time of paint and the permeability (melt viscosity of powder coatings) of this coating inside a rotator coil are taken into consideration, use of the bisphenol mold epoxy resin which carried out epoxidation of bisphenol A, Bisphenol F, the bisphenol S, etc., or a novolak mold polyfunctional epoxy resin is desirable. Moreover, in the case of a bisphenol mold epoxy resin, it is desirable, and 450-4000, and when it is a novolak mold polyfunctional epoxy resin, the thing of weight per epoxy equivalent 190-220 is more preferably desirable [the weight per epoxy equivalent / the thing of 450-1000 is good and]. Moreover, when giving high Tg according to an application, use of a novolak mold polyfunctional epoxy resin, especially the novolak mold polyfunctional epoxy resin of weight per epoxy equivalent 190-220 is desirable. If a novolak mold polyfunctional epoxy resin is used together to a bisphenol mold epoxy resin, crack-proof nature, thermo-cycle-proof nature, and impregnating ability can be satisfied to coincidence, maintaining a high Tg point. (a) weight per epoxy equivalent can combine with a kind of the bisphenol mold epoxy resin of 450-4000, two or more sorts and a kind of the novolak mold polyfunctional epoxy resin of the (b) weight per epoxy equivalent 190-220, or two sorts or more in this case. It is a kind of the bisphenol A mold epoxy resin of weight per epoxy equivalent 450-4000, two or more sorts and a kind of the novolak mold polyfunctional epoxy resin of weight per epoxy equivalent 190-220, or two sorts or more of combination preferably, and they are a kind of the bisphenol A mold epoxy resin of weight per epoxy equivalent 450-1000, two or more sorts and a kind of the novolak mold polyfunctional epoxy resin of weight per epoxy equivalent 190-220, or two sorts or more of combination especially preferably. As for the operating rate, it is desirable to use it by (a):(b) =20:80-80:20, and to use at a rate of 35:65-65:35 still more preferably as the weight section.

[0009] As a curing agent (B) used by this invention, an acid anhydride, amines, phenols, amides, imidazole derivatives, etc. are mentioned, for example. As an acid anhydride, alicyclic carboxylic anhydrides, such as the anhydride of aliphatic carboxylic acid, such as aromatic series carboxylic anhydrides, such as a phthalic-acid anhydride, trimellitic anhydride, a pyromellitic acid anhydride, a benzophenone tetracarboxylic acid anhydride, and ethylene glycol trimellitic anhydride, an azelaic acid, a sebacic acid, and dodecane diacid, a tetrahydrophthalic anhydride, a hexahydrophthalic anhydride, a NAJIKKU acid anhydride, a beef fat acid anhydride, and himic acid anhydride, etc. are mentioned, for example.

[0010] As amines, diamino diphenylmethane, diamino diphenyl sulfone, diamino diphenyl ether, etc. are mentioned, for example, and a dicyandiamide etc. is mentioned as amides. As phenols, for example Bisphenol A, tetra-bromine bisphenol A, A Bisphenol F, Bisphenol S, 4, and 4'-biphenyl phenol, 2 and 2'-methylenebis (4-methyl-6-tert-butylphenol), 2 and 2'-methylenebis (4-ethyl-6-tert-butylphenol), 4,4'-butyrylene-bis(3-methyl-6-tert-butylphenol), 1, 1, 3-tris (2-methyl-4-hydroxy-5-tert-butylphenol), Tris hydroxyphenyl methane, pyrogallol, the phenols that have a diisopropylidene skeleton, The phenols which have fluorene frames, such as a 1 and 1-G 4-hydroxyphenyl fluorene, Polyphenol compounds, such as phenol-ized polybutadiene, a phenol, Cresol, ethylphenol, butylphenol, and octyl phenol Bisphenol A, bromine-ized bisphenol A, Bisphenol F The novolak resin which uses various phenols, such as Bisphenol S and naphthols, as a raw material, Various novolak resin, such as xylylene frame content phenol novolak resin, dicyclopentadiene frame content phenol novolak resin, and fluorene frame content phenol novolak resin, etc. is mentioned.

[0011] As ~~imidazole derivatives~~, for example 2-methylimidazole, 2-phenylimidazole, 2-undecylimidazole, 2-heptadecylimidazole, 2-phenyl-4-methylimidazole, 1-benzyl-2-phenylimidazole, 1-benzyl-2-methylimidazole, 1-cyanoethyl-2-methylimidazole, 1-cyanoethyl-2-phenylimidazole, 1-cyanoethyl-2-undecylimidazole, 2, 4-diamino-6 (2'-methyl imidazole (1')) ethyl-s-triazine, 2, 4-diamino-6 (2'-undecyl imidazole (1')) ethyl-s-triazine, 2, 4-diamino-6 (2'-ethyl, 4-methyl imidazole (1')) ethyl-s-triazine, 2 A 4-diamino-6 (2'-methyl imidazole (1')) ethyl-s-triazine isocyanuric acid addition product,

2:3 addition products of 2-methylimidazole isocyanuric acid, a 2-phenylimidazole isocyanuric acid addition product, The 2-phenyl -3, 5-dihydroxy methyl imidazole, a 2-phenyl-4-hydroxymethyl-5-methyl imidazole, The 1-cyano ethyl-2-phenyl -3, the various imidazole derivatives of 5-dicyano ethoxy methyl imidazole, And salts with multiple-valued carboxylic acids, such as these imidazole derivatives, a phthalic acid, isophthalic acid, a terephthalic acid, trimellitic acid, pyromellitic acid, naphthalene dicarboxylic acid, a maleic acid, and oxalic acid, etc. are mentioned.

[0012] Although suitably chosen by the application of powder coatings, the property, etc., it is acid anhydrides, phenol novolak resin, and amides preferably which curing agent is used among these curing agents (B), and it is a dicyandiamide still more preferably. In the equivalent ratio of a curing agent to the epoxy group of an epoxy resin (A), the range of the amount of the curing agent used is usually 0.3-2.0, the range of it is 0.4-1.5 preferably, and it is used in 0.5-1.0 still more preferably. Moreover, the above-mentioned curing agent can also mix and use two or more sorts. When the above-mentioned curing agent is smaller than 0.3, the fall of the adhesive strength of a powder-coatings hardened material is caused, and when [than 2.0] more, at the time of paint, the melt viscosity of epoxy resin powder coatings becomes high, or foams with a rapid hardening reaction, and there is an inclination for the impregnating ability of a between [a coil or a core] to become scarce.

[0013] As a hardening accelerator (C) which can be used for this invention, phenols, such as phosphines, such as salts of the diaza compounds of amides [, such as above mentioned imidazole derivatives, an above mentioned dicyandiamide, etc.,], 1, and 8-diazabicyclo (5.4.0) undecene-7 grade and those phenols, said multiple-valued carboxylic acids, or phosphinic acid, triphenyl phosphine, and tetra-phenyl phosphonium tetraphenylborate, 2 and 4, and 6-tris aminomethyl phenol, etc. are mentioned. although it is suitably chosen by the class of the cure rate of the powder coatings obtained, hardened material nature, and curing agent which [of these hardening accelerators] is used -- desirable -- imidazole derivatives -- it is imidazole system azine derivative, 2 [for example,], and 4-diamino-6-(2'-methyl imidazole (1')) ethyl-s-triazine still more preferably. the blending ratio of coal of these hardening accelerators -- the epoxy resin 100 weight section -- receiving -- usually -- 0.01 - 5 weight section -- desirable -- 0.05 - 3 weight section -- it is 0.1 - 2 weight section still more preferably.

[0014] As an inorganic filler (D) which can be used in this invention, a melting crushing silica, Spherical silicas, such as a crystal crushing silica and a spherical silica, silicon carbide, Silicon nitride, boron nitride, a calcium carbonate, a magnesium carbonate, a barium sulfate, A calcium sulfate, a mica, talc, clay, an aluminum oxide, a magnesium oxide, A zirconium dioxide, an aluminum hydroxide, a magnesium hydroxide, a calcium silicate, Aluminum silicate, silicic acid lithium aluminum; a silicic acid zirconium, Barium titanate, glass fiber, a carbon fiber, molybdenum disulfide, etc. are mentioned. It is a melting crushing silica, a crystal crushing silica, a spherical silica, a calcium carbonate, an aluminum oxide, an aluminum hydroxide, and a calcium silicate preferably, and they are a melting crushing silica, a crystal crushing silica, a spherical silica, and a calcium carbonate more preferably. Moreover, when thermo-cycle-proof nature is taken into consideration, powder silicas, such as a spherical silica and melting crushing silica and a crystal crushing silica, are still more desirable. A kind of independent use may also mix two or more sorts, these fillers may use, and the amount used is 20 - 65 % of the weight usually 40 - 55 % of the weight still more preferably 30 to 60% of the weight preferably to the whole constituent. Moreover, as for a kind independent or mean particle diameter when two or more sorts are mixed, it is desirable that these fillers use a 5-50-micrometer thing. What performed surface treatment by the coupling agent can be used for the above-mentioned inorganic bulking agent (D).

[0015] as a styrene butadiene rubber (E) as a stress relaxation agent added by this invention, the epoxy denaturation styrene butadiene rubber which carried out epoxy group denaturation of a non-denaturalized styrene butadiene rubber or a part of butadiene section, for example mentions -- having -- these -- a kind -- or two or more sorts can be mixed and it can use. Preferably, it is epoxy denaturation styrene-butadiene rubber. Styrene of epoxy denaturation styrene-butadiene rubber: The component ratio of a butadiene is usually (10:90) - (50:50), and it is - (25:75) (45:55) preferably, and the rate of epoxy denaturation in that in all the butadienes component of epoxy denaturation styrene-butadiene rubber is

usually 5-40-mol %, is 5-30-mol % preferably, and is 5-25-mol % still more preferably. moreover -- as the amount used -- the epoxy resin (A) 100 weight section -- receiving -- usually -- 3 - 20 weight section -- desirable -- 5 - 15 weight section -- it is 5 - 10 weight section still more preferably.

[0016] In the constituent of this invention, a coloring agent, a coupling agent, a leveling agent, lubricant, etc. can be suitably added according to the purpose. Phthalocyanine, azo, JISUAZO, Quinacridone, anthraquinone, flavanthrone, and peri non, as a coloring agent, there is especially no limit and the various organic system coloring matter of perylene, dioxazine, condensation azo, azomethine, or a methine system is mentioned for titanium oxide, a lead sulfate, a zinc oxide, chrome yellow, zinc yellow, Chrome Vermilion, rouge, cobalt purple, Berlin blue, ultramarine blue, carbon black, chrome green, chromic oxide, cobalt green, etc. as an inorganic pigment again.

[0017] As a coupling agent, 3-glycidoxypropyltrimetoxysilane, 3-glycidoxypropylmethyldimetoxysilane, 3-glycidoxypropylmethyldimetoxysilane, 2-(3, 4-epoxycyclohexyl) ethyltrimethoxysilane, N-(2-aminoethyl)3-aminopropyl methyl dimethoxysilane, N-(2-aminoethyl)3-aminopropyl methyl trimetoxysilane, 3-aminopropyl triethoxysilane, 3-mercapto propyltrimethoxysilane, Vinyltrimetoxysilane, an N-(2-(vinylbenzylamino)ethyl)3-aminopropyl trimethoxysilane hydrochloride, 3-methacryloxy propyl trimethoxysilane, 3-chloropropylmethyldimetoxysilane, Silane system coupling agents, such as 3-chloropropyltrimetoxysilane, Isopropyl (N-ethylamino ethylamino) Titanate, isopropylisostearoyl titanate, CHITANYUUMUJI (JIOKUCHIRUPIRO phosphate) Oxy-acetate, Tetra-isopropanal PIRUJI (dioctyl FOSU fight) Titanate, Titanium system coupling agents, such as neo ARUKOKISHITORI (p-N-(beta-aminoethyl) aminophenyl) titanate, Zr-acetylacetonate, Zr-methacrylate, Zr-propionate, Neo alkoxy zirconate, NEOARUKOKISHITORISU neo decanoyl zirconate, Neo alkoxy tris (dodeca noil) Benzene sulfonyl zirconate, Neo alkoxy tris (ethylene diamino ethyl) zirconate, Neo alkoxy tris (m-aminophenyl) Zirconate, ammonium zirconium carbonate, Although zirconiums, such as aluminum-acetylacetonate, aluminum-methacrylate, and aluminum-propionate, or an aluminate coupling agent is mentioned, they are a silicon system coupling agent or a titanate system coupling agent preferably.

[0018] As a leveling agent, the oligomer of the molecular weight 4000-12000 which consists of acrylate, such as ethyl acrylate, butyl acrylate, and 2-ethylhexyl acrylate, an epoxidation soybean fatty acid, epoxidation loon ethyl alcohol, hydrogenation castor oil, a titanium system coupling agent, etc. are mentioned. As lubricant, for example, hydrocarbon system lubricant, such as paraffin wax, micro wax, and polyethylene wax, A lauric acid, a myristic acid, a palmitic acid, stearin acid, arachidic acid, Higher-fatty-acid system lubricant, such as behenic acid, a stearyl amide, a palmityl amide, Higher-fatty-acid amide system lubricant, such as oleylamide, methylenebisstearamide, and ethylene-bis-stearamide, Hardening castor oil, butyl stearate, ethylene glycol monostearate, Higher-fatty-acid ester system lubricant, such as pentaerythritol (Monod, G, tree, or tetrapod -) stearate, Cetyl alcohol, stearyl alcohol, a polyethylene glycol, Alcoholic system lubricant, such as poly glycerol, a lauric acid, a myristic acid, A palmitic acid, stearin acid, arachidic acid, behenic acid, a ricinoleic acid, Natural waxes, such as metallic soap which are metal salts, such as magnesium, such as a naphthenic acid, calcium, cadmium, barium, zinc, and lead, a carnauba wax, candelilla wax, a dense low, and montan wax, are mentioned.

[0019] The epoxy resin powder coatings of this invention carry out melting mixing of each above-mentioned component, are obtained, are usually pulverized, and use is presented with them. As for the grain size of these powder coatings, it is desirable that it is usually in the range of 20-250 micrometers. In order to prepare the epoxy resin powder coatings of this invention, after performing melting mixing processing for combination components, such as a coupling agent, a flame retarder, a coloring agent, a leveling agent, and lubricant, below 110 degrees C by the kneader, an extruder, etc. after dry blending using a Henschel mixer etc., by request besides the above-mentioned epoxy resin, a curing agent, a hardening accelerator, and a filler, cooling solidification of the mixture is carried out, and it classifies after pulverizing, the thing of a desired grain size is extracted, and it considers as epoxy resin powder coatings.

[0020] The goods of this invention are the goods painted by the various methods of application, such as a fluidized bed coating process, an electrostatic flow tub method, an electrostatic spray method, and

cascade process, using the epoxy resin powder coatings of this invention, for example, the locked rotor for motors is mentioned. Paint of this rotator is painted inside a core front face, a core, and a coil. For example, when painting using a fluidized bed coating process, although what is necessary is just more than the melting temperature of powder coatings, preferably, at 160 degrees C - 190 degrees C, after a preheating, it is immersed and 150 degrees C - 200 degrees C of rotator cores are painted at a fluidized-bed-dip-coating tub. Therefore, the powder coatings adhering to a core front face are fused on the core front face. Next, full hardening of the melt is carried out by heating this rotator core further. As whenever [stoving temperature], 140 degrees C - 150 degrees C - 210 degrees C 220 degrees C are 160 degrees C - 200 degrees C still more preferably preferably. Heating time is 10 minutes - 1 hour. In this way, the rotator of this invention is obtained by carrying out cutting removal of the hardened excessive resin which has fixed on core front faces other than the core space section of the obtained rotator with a cutting tool cutting edge etc. Moreover, it is processed by attaching the above-mentioned rotator with need components, such as bearing and York, and the motor which has the rotator of this invention is obtained.

[0021]

[Example] Next, although an example explains this invention still more concretely, this invention is not limited only to these examples. In an example and the example of a comparison, the "section" means the weight section.

[0022] The example 1 EPO MIKKU R-302 (product made from Mitsui petrochemistry, 85 degrees C of softening temperatures) 55 section, The EPO MIKKU R-304 (product made from Mitsui petrochemistry, 105 degrees C of softening temperatures) 10 section, the EOCN-104S (Nippon Kayaku make, 92 degrees C of softening temperatures)35 section, and a spherical silica (the DENKI KAGAKU KOGYO make --) The FB-74 129 section, the titanate system coupling agent (Ajinomoto make, KR-46B) 0.6 section, The dicyandiamide (product made from oil-ized shell epoxy, DICY7) 4.4 section, After the mixer's having ground the 2 MZ-A(Shikoku formation make, 2 MZ-A) 1.5 section, the epoxy denaturation styrene-butadiene-rubber (product made from die cel chemistry, A-1020) 8 section, and the leveling agent (Kusumoto formation make, PL- 525) 1 section and mixing, melting mixing was carried out using the biaxial kneader. After cooling the obtained kneading object and solidifying, it ground and the epoxy resin powder coatings of this invention were obtained through 250-micrometer screen. Subsequently, the obtained epoxy resin powder coatings are applied to the locked rotor of 60mmphi and 45mm of product thickness by which the preheating of the element assembly temperature was carried out to 180 degrees C by the fluidized bed coating process, postcure is carried out under the conditions for 180 more degree-Cx 10 minutes, and it is 5 kgf/cm2. The crack generates and was good, when the above air was sprayed for 10 minutes and it cooled compulsorily. Moreover, the rotator of this invention obtained by performing cutting processing with the cutting tool cutting edge etc. from this rotator core front face by extent to which a core surface of metal exposes excessive hardening resin was used as the test piece for a thermo-cycle trial. - When the thermo-cycle trial was carried out under conditions with ten cycles for 30 degrees C - 160 degree-Cx 2 hours each, the crack which affects it to sticking tendency ability generates and was good.

[0023] The example of comparison 1 EPO MIKKU R-302 (product made from Mitsui petrochemistry, 85 degrees C of softening temperatures) 55 section, The EPO MIKKU R-304 (product made from Mitsui petrochemistry, 105 degrees C of softening temperatures) 10 section, the EOCN-104S (Nippon Kayaku make, 92 degrees C of softening temperatures)35 section, and a spherical silica (the DENKI KAGAKU KOGYO make --) The FB-74 115 section, the titanate system coupling agent (Ajinomoto make, KR-46B) 0.6 section, After the mixer's having ground the dicyandiamide (product made from oil-ized shell epoxy, DICY7) 4.4 section, the 2 MZ-A(Shikoku formation make, 2 MZ-A) 1.5 section, and the leveling agent (Kusumoto formation make, PL- 525) 1 section and mixing, melting mixing was carried out using the biaxial kneader. After cooling the obtained kneading object and solidifying, it ground and the epoxy resin powder coatings for a comparison were obtained through 250-micrometer screen. Subsequently, the obtained epoxy resin system powder coatings are applied to the locked rotor of 60mmphi and 45mm of product thickness by which the preheating of the element assembly temperature

was carried out to 180 degrees C by the fluidized bed coating process, postcure is carried out under the conditions for 180 more degree-Cx 10 minutes, and it is 5 kgf/cm2. When the above air was sprayed for 10 minutes and it cooled compulsorily, the crack arose along with the opening slot section of a rotator core. Moreover, the rotator obtained by performing cutting processing with the cutting tool cutting edge etc. from this rotator core front face by extent to which a core surface of metal exposes excessive hardening resin was used as the test piece for a thermo-cycle trial. - When the thermo-cycle trial was carried out under conditions with ten cycles for 30 degrees C - 160 degree-Cx 2 hours each, the crack number increased and crack length was also growing.

[0024] After the mixer's having ground the mixture of the component presentation (a weight ratio, section) shown in two to example 3 table 1 and mixing, melting mixing was carried out using the biaxial kneader. After cooling the obtained kneading object and solidifying, it ground and the epoxy resin powder coatings of this invention were obtained through 250-micrometer screen. Subsequently, the obtained epoxy resin powder coatings are applied to the locked rotor of 60mmphi and 45mm of product thickness by which the preheating of the element assembly temperature was carried out to 180 degrees C by the fluidized bed coating process, postcure is carried out under the conditions for 180 more degree-Cx 10 minutes, and it is 5 kgf/cm2. The above air was sprayed for 10 minutes, it cooled compulsorily, and generating of a crack was observed. Moreover, the rotator of this invention obtained by performing cutting processing with the cutting tool cutting edge etc. from this rotator core front face by extent to which a core surface of metal exposes excessive hardening resin was used as the test piece for a thermo-cycle trial. - The thermo-cycle trial was carried out under the conditions of 10 cycle for 30 degrees C - 160 degree-Cx 2 hours each. A result is shown in Table 1.

[0025] After the mixer's having ground the mixture of the component presentation (a weight ratio, section) shown in example of comparison 2 table 1 and mixing, melting mixing was carried out using the biaxial kneader. After cooling the obtained kneading object and solidifying, it ground and the epoxy resin powder coatings for a comparison were obtained through 250-micrometer screen. Subsequently, it applies to the locked rotor of 60mmphi and 45mm of product thickness to which element assembly temperature carried out the preheating of the obtained epoxy resin powder coatings to 180 degrees C by the fluidized bed coating process, postcure is carried out under the conditions for 180 more degree-Cx 10 minutes, and it is 5 kgf/cm2. The above air was sprayed for 10 minutes, it cooled compulsorily, and generating of a crack was observed. Moreover, the rotator obtained by performing cutting processing with the cutting tool cutting edge etc. from this rotator core front face by extent to which a core surface of metal exposes excessive hardening resin was used as the test piece for a thermo-cycle trial. - The thermo-cycle trial was carried out under the conditions of 10 cycle for 30 degrees C - 160 degree-Cx 2 hours each. A result is shown in Table 1.

[0026]

[Table 1]

Table 1 Presentation table and performance evaluation Example 1 Example 2 Example 3 Example 1 of a comparison Example 2 of a comparison (A) Epoxy resin (1) 10 10 55 10 60 Epoxy resin (2) 55 55 10 55 Epoxy resin (3) 35 35 35 35 40 (B) Curing agent 4.4 4.4 4.1 4.4 4.3 (C) Hardening accelerator 1.5 1.5 1.5 1.5 1.5 (D) Melting crushing silica 129 Spherical silica 129 129 115 115 (E) Stress relaxation agent (1) 8 8 5 Coupling agent A 0.6 0.6 0.6 0.6 0.6 Additive 1 1 1 11 ---------- A forced-cooling trial O O O x x thermo-cycle trial O O O x Rate of x inclination flow O O O O O bending elastic modulus (kgf/mm) 814 833 795 1021 1008 [0027] Epoxy resin (1): EPO MIKKU R-304 (the product made from the Mitsui petrochemistry, 105 degrees C of softening temperatures)

Epoxy resin (2): EPO MIKKU R-302 (the product made from the Mitsui petrochemistry, 85 degrees C of softening temperatures)

Epoxy-resin (3): EOCN-104S (the Nippon Kayaku make, 92 degrees C of softening temperatures)

curing agent: -- dicyandiamide hardening-accelerator: -- 2 MZ-A (Shikoku formation make)

Melting crushing silica: RD-8 (made in Tatsumori, mean particle diameter of 13 micrometers)

spherical -- silica:FB-74 (the DENKI KAGAKU KOGYO make, mean particle diameter of 35 micrometers)

Stress-relaxation agent (1): Epoxy denaturation styrene butadiene rubber (the product made from die cel chemistry, EPO friend A-1020; styrene: butadiene = rate % of 20 mols of epoxidation to 40:60 and a butadiene)
Coupling agent (A): Titanate system coupling agent (the Ajinomoto make, KR-46B)
Additive (leveling agent) :P L-525 (Kusumoto formation make)
[0028] Moreover, the performance-evaluation method and valuation basis of a paint product which painted the epoxy resin powder coatings of this invention, and were acquired are as follows.
(1) element assembly temperature applies the epoxy resin powder coatings obtained in forced-cooling trial each example and each example of a comparison to the locked rotor of 60mmphi and 45mm of product thickness by which the preheating was carried out to 180 degrees C by the fluidized bed coating process, and carries out postcure under the conditions for 180 more degree-Cx 10 minutes to it -- making -- 5 kgf/cm2 the above air -- blasting during 10 minutes -- it cooled compulsorily. At that time, the situation of the crack in the element assembly section was observed, it classified with the next notation, and O was judged to be forced-cooling nature "fitness."
O : there is no crack immediately after forced cooling, and several days after is eternal.
O : what there is no crack immediately after forced cooling, and produces a crack one day or more after.
x: One or more cracks are immediately after forced cooling.
[0029] (2) This invention obtained by performing cutting processing with the cutting tool cutting edge etc. by extent to which a core surface of metal exposes excessive hardening resin from this rotator core front face after the above-mentioned forced-cooling trial that applied the epoxy resin powder coatings obtained in thermo-cycle trial each example and each example of a comparison, and was obtained, and the rotator for a comparison were used as the test piece for a thermo-cycle trial. - The thermo-cycle trial was carried out under the conditions of 10 cycles in 30 degrees C - 160 degree-Cx 2 hours each. After the trial, the generated crack was classified as follows and evaluated.
O : there is no destructive crack of a resin layer and it is satisfactory as sticking tendency ability.
x: What a crack grows and destroys a resin layer.
[0030] (3) Carry out about 0.5g weighing capacity of the rate powder coatings of inclination flow, use a tablet molding machine, and it is 400 kgf/cm2. It fabricates by the pressure. It was left for 3 minutes on the glass plate of 60 tilt angles which set this fabricated tablet under 180-degree-C ambient atmosphere, and the distance which flowed was measured. The die length was classified with the next notation, and O was made into the rate of inclination flow "fitness."
O : less than [thing x:15mm] [0031] 25mm or more below more than thing **:15mm-25mm (4) the bending test which carried out the preheating of the powder coatings which tableted [bending ********] to 180 degrees C -- public funds -- what cast by the transfer mold method in the mold (the thickness of 4mm, width of face of 10mm, die length of 120mm), and subsequently carried out postcure for 10 minutes in the condition was made into the sample for bending tests. The bending test was performed on condition that the following using this sample, and the elastic modulus then measured was made into the bending elastic modulus.
Measuring condition: Edge span distance of 64mm, passing speed 3 mm/min
[0032] The example 4 EPO MIKKU R-302 (product made from Mitsui petrochemistry, 85 degrees C of softening temperatures) 55 section, The EPO MIKKU R-304 (product made from Mitsui petrochemistry, 105 degrees C of softening temperatures) 10 section, the EOCN-104S (Nippon Kayaku make, 92 degrees C of softening temperatures)35 section, and a calcium carbonate (Maruo Calcium --) The R GCC 129 section, the titanate system coupling agent (Ajinomoto make, KR-46B) 0.6 section, The dicyandiamide (product made from oil-ized shell epoxy, DICY7) 4.4 section, After the mixer's having ground the 2 MZ-A(Shikoku formation make, 2 MZ-A) 1.5 section, the epoxy denaturation styrene-butadiene-rubber (product made from die cel chemistry, A-1020) 8 section, and the leveling agent (Kusumoto formation make, PL- 525) 1 section and mixing, melting mixing was carried out using the biaxial kneader. After cooling the obtained kneading object and solidifying, it ground and the epoxy resin powder coatings of this invention were obtained through 250-micrometer screen. Subsequently, the obtained epoxy resin powder coatings are applied to the locked rotor of 60mmphi and 45mm of product

thickness by which the preheating of the element assembly temperature was carried out to 180 degrees C by the fluidized bed coating process, postcure is carried out under the conditions for 180 more degree-Cx 10 minutes, and it is 5 kgf/cm2. The crack generates and was good, when the above air was sprayed for 10 minutes and it cooled compulsorily.

[0033]

[Effect of the Invention] An epoxy resin (A), the curing agent (B), the hardening accelerator (C), the inorganic filler (D), and the epoxy resin constituent that contains styrene-butadiene rubber (E) as an indispensable component as a stress relaxation agent are useful as powder coatings for locked rotors which were excellent in the crack-proof nature and impregnating ability by forced cooling after heat hardening, and also were excellent also in thermo-cycle-proof nature.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The epoxy resin constituent which contains styrene-butadiene rubber (E) as an epoxy resin (A), a curing agent (B), a hardening accelerator (C), an inorganic filler (D), and a stress relaxation agent.

[Claim 2] The epoxy resin constituent of claim 1 whose epoxy resin (A) is mixed resin of the bisphenol mold epoxy resin (a) of weight per epoxy equivalent 450-1000, and the novolak mold polyfunctional epoxy resin (b) of weight per epoxy equivalent 190-220.
[Claim 3] The epoxy resin constituent of claims 1 or 2 whose curing agents (B) are dicyandiamides.
[Claim 4] The epoxy resin constituent of claim 1 whose hardening accelerator (C) is an imidazole system azine derivative thru/or any 1 term of 3.
[Claim 5] The epoxy resin constituent of the claim 1 thru/or any 1 term of 4 whose inorganic filler (D) is a calcium carbonate or a powder silica.
[Claim 6] The epoxy resin constituent of claim 1 whose inorganic filler (D) is a powder silica thru/or any 1 term of 4.
[Claim 7] Claim 5 or 6 epoxy resin constituents whose powder silica is a melting crushing silica, a crystal crushing silica, or a spherical silica.
[Claim 8] Styrene in styrene-butadiene rubber (E): The epoxy resin constituent of claim 1 whose component ratio of a butadiene is - (25:75) (45:55) thru/or any 1 term of 7.
[Claim 9] The epoxy resin constituent of claim 1 whose styrene butadiene rubber (E) is a styrene butadiene rubber which carried out epoxy denaturation of a part of butadiene section thru/or any 1 term of 8.
[Claim 10] The epoxy resin constituent of claim 9 whose rate of epoxy denaturation in the styrene butadiene rubber which carried out epoxy denaturation is all 5-25-mol % in a butadiene component.
[Claim 11] Epoxy resin powder coatings which consist of an epoxy resin constituent of claim 1 thru/or any 1 term of 10.
[Claim 12] Goods painted with the epoxy resin powder coatings of claim 11 term.
[Claim 13] Goods of claim 12 whose goods are locked rotors.
[Claim 14] The motor which has the locked rotor of claim 13.

[Translation done.]